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# Frameworks for Understanding Interactive Innovation Processes

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# Frameworks for Understanding Interactive Innovation Processes

## Abstract

In recent years there has been considerable activity, by business analysts and academics, in developing new approaches to understanding contemporary innovation processes. This has resulted in the emergence of a large number of conceptual alternatives, with many overlapping features. It is the aim of this paper to outline and compare the most popular of these frameworks, and develop a model incorporating their important features. The integrated model should assist businesses examining their innovation processes by providing a single-point guide to key issues; it should also help public-sector policy makers understand key leverage points for improving the environment for innovation.

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## Introduction

Technological and social advancements have resulted in the need for new forms of organisation for successful innovation. In the past, innovation processes may have been effectively managed by individual firms, however this is no longer true. Successful innovation is increasingly seen to be the result of a team effort between a collective of industry players.

*Interactive* innovation processes lie at the heart of success in the new economic circumstances. As the Bureau of Industry Economics (BIE) (1991:7) notes:

For some time, studies of the innovation process have stressed the importance of networks to successful innovation, over-turning the traditional model which characterises innovation as a linear sequence running from basic research, through product development, to production and marketing. Innovation is now seen as an interactive process requiring intense traffic in facts, ideas and reputational information within and beyond the firm.

It is now clear that innovating firms ‘cannot be analysed in isolation: innovation capability depends in fact also on the amount of information that each firm is able to receive from the environment in which it operates’ (Antonelli 1996: 284). This ‘interactive’ view of innovation is the basis for many conceptual elaborations of the innovation process, all of

which emphasise the increasing complexity of successful innovation and the importance of external knowledge sources. Table 1 lists the leading models.

**Table 1: Interactive Innovation Frameworks**

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<ul style="list-style-type: none"> <li>• development blocks (Dahmen 1988);</li> <li>• complexes (Glatz and van Tulder 1989; Marceau 1995);</li> <li>• innovation milieux (Camagni 1991; Ratti et al. 1997);</li> <li>• complex products and systems (Hobday et al. 2000b);</li> <li>• competence blocs (Eliasson 1997);</li> <li>• technological regimes (Nelson and Winter 1982);</li> <li>• industrial filieres (van Tulder and Junne 1988);</li> <li>• innovation districts (Pyke et al. 1990);</li> <li>• sectoral innovation systems (Breschi and Malerba 2000);</li> <li>• regional innovation systems (Cooke 1997);</li> <li>• technological innovation systems (Carlsson and Stankiewicz 1991);</li> <li>• national innovation systems (Lundvall 1992; Nelson 1993);</li> <li>• innovation networks (De Bresson and Amesse 1991);</li> <li>• business networks (BIE 1991);</li> <li>• value-chains (Walters and Lancaster 2000); and</li> <li>• clusters (Porter 1990).</li> </ul>
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Clearly there has been considerable activity in developing new approaches to understanding contemporary innovation processes. However, the breadth of alternatives, and their similarities, can be bewildering for entrepreneurs and policy makers seeking practical guidance. It is the aim of this paper to outline and compare the key frameworks, leading to the development of a model incorporating their important features. The integrated model should assist businesses examining their innovation processes by providing a single-point guide to key issues, it should also help public-sector policy makers understand key leverage points for improving the environment for innovation.

This paper focuses on four key approaches: systems, networks, value-chains and clusters. These frameworks have the highest profile in the academic and business literature and are best able to incorporate the main ideas associated with the approaches listed in Table 1. The discussion to follow summarises the four frameworks, before comparing them and developing an integrated model.

## Innovation Systems

An innovation system can be defined as a collective of ‘organisations, institutions and people that interact in the production and diffusion of new economically useful knowledge (Lundvall 1992: 11). The original and most common approach to examining innovation systems is at the national level, an approach first promoted by Freeman (1987). Key contributions have since been made by Lundvall (1992), Nelson (1993) and Edquist (1997). Such literature reveals increasing interest among analysts in other levels of study, such as regional, local, sectoral and technological, where mapping and understanding key relationships is more manageable<sup>1</sup> (cf. Sornn-Friese 2000: 4).

Although the innovation system approach emerged only a decade or so ago, Edquist and McKelvey (2000: xi) note it has:

... diffused surprisingly fast in the academic world as well as in the realms of public innovation policy making and firm innovation strategy formulation. The OECD has been particularly influential in using and further developing empirical analyses and research using this approach. 'Systems of innovation' is at the centre of modern thinking about innovation and the relations of innovation to economic growth, competitiveness and employment.

The innovation system approach differs from earlier analytical approaches in assuming that innovation relies primarily on interactions between institutions and people (Landry and Amara 1998: 261). Further, the innovation system approach looks beyond formal R&D programs as a key determinant of innovation. As Edquist (1999: 10) notes:

... many if not most innovations emerge ... through the learning process immanent in ordinary economic activities. In addition, innovations are not only developed but also produced, diffused, and used. They also change during these processes. All the factors and processes mentioned here are included in a system of innovation – but not in an R&D system!

All the features of innovation systems stem from the collective nature of successful innovation efforts. For any organisation, success relies on relationships with *external* parties. This view is supported by numerous empirical studies, an example of which is a rigorous examination of an innovation system by Landry and Amara (1998: 274). Their case-study work indicates that 'innovative firms develop more interactions with outside sources of ideas, information and technology than non-innovative firms do'. In many respects, an innovation system is a social system in which innovations emerge partly as a result of social interaction between economic actors (Cooke 1998: 11).

According to the OECD (1997a: 9), understanding the links between the actors in innovation processes is the key to improving technology performance. Innovation is seen as the result of a complex set of linkages between actors creating, applying and distributing various kinds of knowledge. Innovation performance depends critically on 'the way these actors relate to each other as elements of a collective system of knowledge creation and use ...'.

System features will have a 'decisive impact on the extent to which firms can make innovation decisions, and on the modes of innovation which are undertaken' (Edquist 1999: 7-8). There are four key drivers of innovation in contemporary innovation systems – knowledge flows, institutions, economic competence and interactive learning. These are the main innovation inputs discussed in the systems literature.

## ***Knowledge Flows***

The current popularity of the innovation system approach reflects the increasing knowledge intensity of economic activity. The framework is often applied to measure the 'knowledge distribution power' of a particular system, which involves the system's ability to facilitate effective knowledge flows. Application of the framework involves tracking the linkages between industry, government and academia in the development of technological and

organisational innovations. The aim is to identify and evaluate the main channels of knowledge flow, to analyse bottlenecks and to suggest approaches to improve the effectiveness of knowledge diffusion (OECD 1997a: 11).

## *Institutions*

Institutions are the ‘rules of the game’ which govern *how* knowledge moves between system participants and the way in which subsequent learning and innovation takes place. Examples of key institutions which affect the performance of innovation systems include: the finance system, the taxation system, the intellectual property-rights system, the education system, and the industrial relations system. Culture and norms of behaviour are also important, including particularly the conceptions of fairness and justice held by system participants (see Amable and Petit 1999):

Nooteboom (2000: 916) suggests that firm-level innovation outcomes are, *to a large extent*, dependent on the institutional context in which firms operate. For example, if the education and training systems are under-resourced by government, firms may find it difficult to access suitably skilled employees to support their innovation efforts.

## *Economic Competence*

Another key feature of innovation systems, highlighted by Carlsson and Stankiewicz (1991), is the *economic competence* of a system’s participants. The outcomes of interactive innovation process are ‘a function of the level and content of economic competence on the part of various agents within the system’ (Carlsson and Stankiewicz 1991: 113). This quality, or economic competence, is the microfoundation upon which the success of the system will rest. Economic competence is a ‘scarce and unequally distributed resource ... not all economic agents ... are equally adept at generating new ideas or absorbing new ideas from outside’ (Carlsson and Stankiewicz 1991: 94).

## *Interactive learning*

*Interactive learning* implies a reliance on multiple sources of tacit knowledge in the learning process. Lundvall (1999: 3) notes that ‘the last decade has witnessed a change in the mode of competition that implies that interactive learning, and forgetting, has become the most important process for determining the position of individuals, firms, regions and countries in competition’.

Interactive learning is essential for long-term survival. A firm that is both effective and efficient at a point in time eventually becomes neither unless it can adapt to changing circumstances (especially changing technology). Hence, it is important to keep options open by maintaining a broad array of innovation interests through multiple relationships.

Compared to the other frameworks examined, the innovation system approach encompasses the broadest range of relationships, looking not only at inter-firm relationships, but also focusing on technical support providers and regulatory framework providers. In many respects this emphasis on relationships with diverse players, and networking/learning in particular institutional contexts, are the features which make the system approach the most comprehensive of the four approaches examined here.

In closing this section on innovation systems, three key measures of a system's performance can be drawn out:

1. Linkages with external parties: best if dense, multistranded, long-term, knowledge-intensive, and based on a mix of market and non-market relationships;
2. Organisations: best if there is a diverse range of organisations with different types and high levels of economic competence; and
3. Outcomes: best if individual participants perceive benefits beyond what they could achieve in isolation, increasing the likelihood of a stable and productive system.

## Networks

The concept of *networks* has traditionally been employed by engineers for understanding complex communications and transport systems. It was not until the 1980s that the concept was adopted by sociologists to explain human systems (De Bresson 1991: 363). Today, the network view has become popular with economists seeking to explain the organisation of industries, particularly in relation to innovation and growth. This literature on networks overlaps the literature on innovation systems, as a key feature of innovations systems is the networks they contain (Archibugi et al. 1999: 6).

According to the Bureau of Industry Economics (BIE) (1991: 5), networks can be defined as:

... arrangements for inter-firm cooperation and collaboration, for example, where firms cooperate in production and marketing, to exchange know-how and market intelligence, to jointly train their employees, to develop research capacities and new markets, to purchase raw materials in bulk, to share equipment and infrastructure and so on.

Whether or not the purpose of collaboration is to innovate, the mere act of cooperating with related firms enhances innovation opportunities. In a simple sense, networks can be considered to be groups of cooperating firms; a particular group may constitute an innovation system, value-chain, cluster, or indeed any other constellation of inter-firm relations – depending on how the network is defined and analysed. This section deals with networks in a generic sense, examining the features of inter-organisational linkages that may apply in a variety of contexts.

Networks may involve only a couple of firms, or they may be quite dense, involving an entire industry sector. The focus of a network may be on one activity, such as training or a specific technical problem, or on the activities of an entire value-chain. The duration of a network may be limited to the life of a short project, or ongoing, across projects. A network may or may not be underpinned by formal relationships (BIE 1991: 5).

Networks are clearly very diverse. Networks are also so complex that theorists have not been able to identify an *ideal* network, although experience suggests that certain features may be advantageous (that is, lead to higher levels of innovation). A better performing network may be one in which key players are closely located; linkages are multi-stranded and stable; each linkage is a key part of participants' business strategies; there are dense informal relations; relationships are well coordinated; there is equality between network members; and the

number of players involved is large enough to provide a rich knowledge source and small enough to be manageable.

Networks are seen as a new way of organising economic activity that avoids the inefficiencies associated with large, highly integrated firms and the shortcomings of straightforward market contracts. Networks facilitate the benefits of specialisation (through easy access to external sources of expertise), without incurring the rising costs of trying to internally manage too many specialist departments (BIE 1991; DeBresson and Amesse 1991).

Empirical studies show that networking can greatly enhance innovation performance and economic outcomes for the parties involved, whether it is pursued formally or informally (see Freeman 1991: 499-501).

The last two frameworks reviewed, *value-chains* and *clusters*, focus on linkages, or in other words, networks. They refer to specific types of networks which may form part of a broader innovation system.

## Value-Chains

The value-chains approach to analysing production and innovation performance places an emphasis on relationships between firms, as do the system and network approaches. The main difference is that the value-chains approach draws particular attention to the forward and backward linkages in the production process (Marceau 1995: 15). This focus tends to preclude attention to lateral relationships, that is, relationships between competitors in the same stage of the production process. It also draws particular attention to inter-*firm* activity, largely ignoring organisations that set framework conditions, such as regulators and R&D providers. The narrowness of the chains approach is useful in focusing attention on particular dimensions of innovation systems. It is considered particularly useful when core firms assemble complex products and lead the innovation activities of other players in the chain (Marceau 1995: 15). However, generally speaking, a more comprehensive picture of innovation activities can be gained by using the value-chains approach in conjunction with the system, network and/or cluster approaches (Normann and Ramirez 1993: 65).

Supply- and value-chains can be conceptualised to examine either a firm's internal production processes or its production processes in the context of the value-added by other firms in an overall supply- or value-chain. It is the latter approach that more closely mirrors the innovation system perspective.

The supply-chain and value-chain frameworks are mostly treated as identical in the literature, with a focus on vertical, backward and forward linkages between customers and suppliers, or between stages in an internal production process. The difference in terminology, shifting from supply to value, reflects the increasing innovativeness of firms in their search for better returns. A focus on supply management has given way to a broader, more innovative focus on value-creation.

The traditional supply-chain approach views firms as occupying a particular position along a vertical chain of production, from which they attempt to effectively manage external resources. This view focuses on operational efficiency in distribution activities. Wisner and Tan (2000: 33) note that the term supply-chain management:



...was initially used in wholesaling and retailing to describe the integration of logistics and physical distribution functions with the goal of reducing delivery leadtimes. Manufacturers and service providers have used the same term to describe integration and partnership efforts with first- and second-tier suppliers to reduce cost and improve quality and delivery timing.

Later thinking often reflects an expanded view of the possibilities open to firms in chains of production. Firms are now seen as inter-dependently creating value, in part by strategically positioning themselves within the production chain. The value-chain approach is often used to provide significant insight into the management of business strategy; these days it is rarely used as a mere operational technique (Cox 1999: 167-169). The value-creating process has become the focus of analysis, with innovation seen as the result of firms working together to co-produce value, by reconfiguring their roles and relationships to 'mobilise the creation of value in new forms by new players' (Normann and Ramirez 1995: 66).

Value creation is facilitated through identification of customer benefits and costs, together with identifying the combinations of knowledge/organisations required to respond appropriately. Hence, effective management of information and relationships are the two key tasks of value-chain management, with value/cost drivers influencing the resource combinations chosen. Note that value-chain management involves combining activities undertaken internally and externally. The overriding goal is to 'create an ever improving fit between competencies and customers' (Walters and Lancaster 2000: 161).

Focusing on the relational aspect of value-chains draws attention to the quality of user-producer interaction. User-producer interaction, in relation to both production and innovation, tends to be a key feature of industry networks, in all their forms – including value-chains, clusters and systems. This is particularly true of value-chains, where user-producer interaction is the primary focus of study.

Indeed, although horizontal relationships in the form of competition between firms are a key driver of innovation, vertical relationships in the form of user-producer interactions have emerged over the past decade or so as similarly crucial to successful innovation outcomes (Lundvall 1988; von Hippel 1988; Fagerberg 1995). The key incentives for user-producer interaction are well summarised by Lundvall (1988: 352-353):

The user ... needs information about new products [and processes], and this information involves not only awareness but also quite specific information about how new 'use value' characteristics relate to his/her specific needs....

The producer will have a strong incentive to monitor what is going on in user units. First, process innovations within user units might be appropriated by producers or represent a potential competitive threat. Second, ... innovations at the user level may imply new demands for ... equipment. Third, the knowledge produced by learning-by-using can only be transformed into new products if the producers have direct contact with users. Fourth, bottlenecks and technological interdependencies, observed within user units, will represent potential markets for the innovating producer. Finally, the producer might be interested in monitoring the competence and learning potential of users in order to estimate their respective capability to adopt new products.

This process of creating value in value-chains is one of developing innovations using the resources immediately available in the user-producer value-chain. The system/network views of production and innovation, and, to a lesser extent, the clusters view, place production and innovation processes in a broader context.<sup>2</sup>

## Clusters

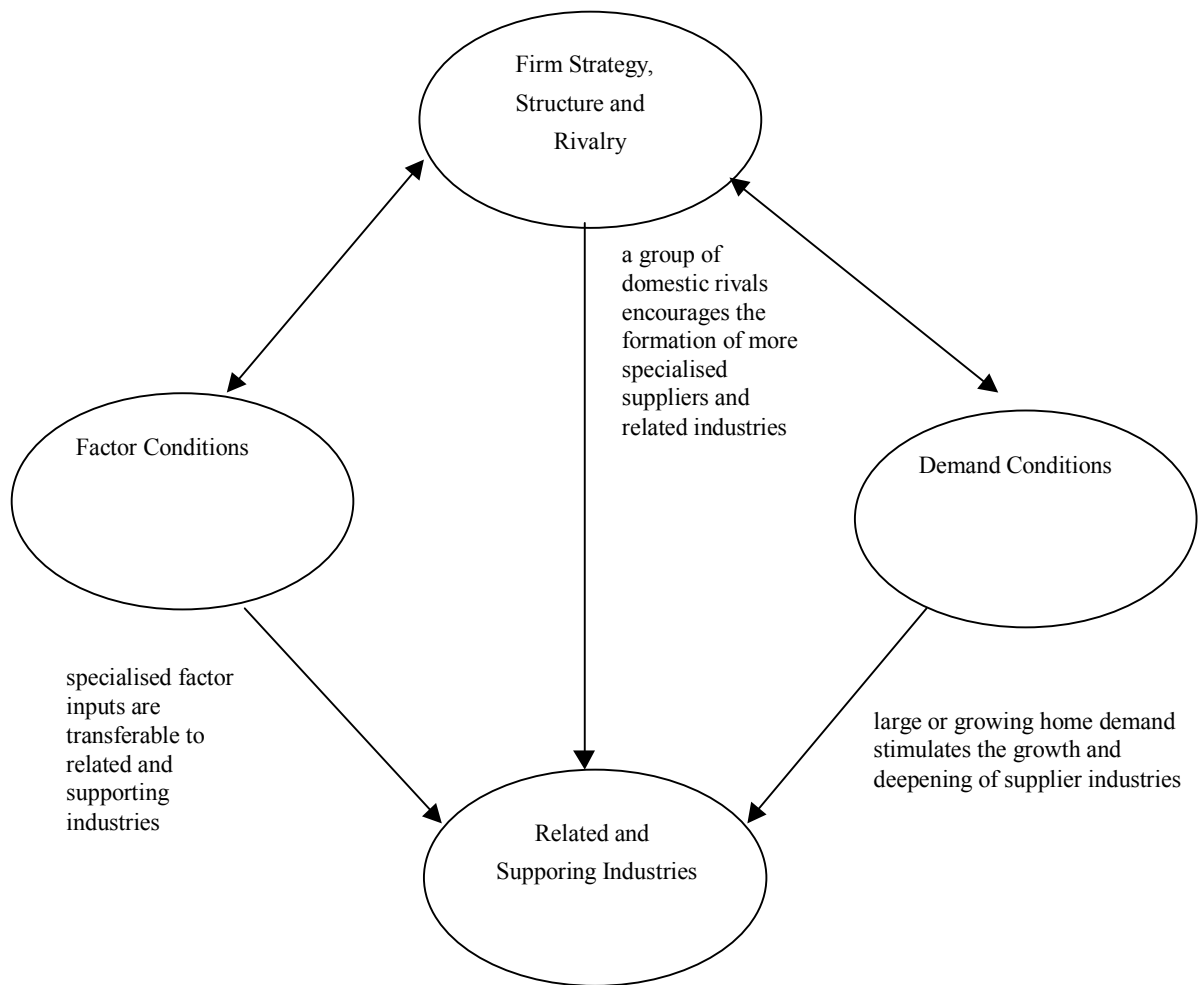
The cluster concept provides a different view of inter-firm relations, again dealing with production and innovation activities, but focusing on vertical *and horizontal* relationships. Clusters often ‘extend downstream to ... customers and laterally to manufacturers of complementary products and to companies in industries related by skills, technologies or common inputs’ (Porter 1998: 310). Clusters often consist of cross-sectoral lateral networks that contain dissimilar and complementary firms specialised around a knowledge base, or a specific link in the value-chain (OECD 1999c: 414).

Compared to the value-chains perspective, the cluster approach typically emphasises a broader array of players. Clusters are often defined to include the role of firm and non-firm players such as providers of infrastructure, R&D, education, training and regulation. Although this suggests a broader view than that provided by the chains perspective, in some ways cluster analysis is narrower, particularly because it is often applied to a *geographical concentration* of interconnected organisations (Porter 1998: 310). The cluster approach emphasises the flow of benefits between linked organisations operating in close geographical proximity to each other. Many of these benefits derive from shared tacit knowledge.

Porter’s comprehensive 1990 study of competitive advantage played a key role in drawing the attention of business leaders, academics and policy-makers to the value of cluster analysis (Baptista 1998: 26). Porter’s (1990b) famous *competitive diamond* is an empirically based analytical tool that can be applied to understand the strength of an economic system, whether it be at national or regional level. In recent years, his framework has been used extensively to examine both national systems and regional clusters.

Figure 1 below highlights the four points of Porter’s diamond of competitive advantage.

Figure 1: Diamond of Competitive Advantage



Source: Based on Porter 1990b: 77.

Two specific factors drive the dynamism of a cluster – localised rivalry and geographical concentration. Rivalry between firms promotes the dynamism of the cluster, while geographical concentration increases the intensity of interactions within the cluster. Rivalry provides a major incentive for investment in three key resources: skilled labour, market-specific knowledge and specialised infrastructure. An effective cluster of firms will draw on common infrastructure and specialised inputs, with their combined demand assisting in upgrading the quality and increasing the supply of key factors of production. Rivalry and geographic concentration leads to dynamism that positively stimulates related and supporting industries, and also promotes the quality and strength of local demand.

## Summary

The four key frameworks, systems, networks, value-chains and clusters is the innovation system approach. An innovation system can be thought of as a complex macro network, containing sub-networks, of which value-chains and clusters are two key types. The innovation system approach emphasises relationships between industry players and can be applied at various levels, including national, regional, local, sectoral and technological. It differs from the other approaches shown in that it has a more specific focus on innovation. It also typically includes consideration of the broadest range of industry players compared to the other frameworks, including, for example, public-sector regulators, public-sector R&D organisations, training institutions and finance providers, in addition to private-sector industry players.<sup>2</sup>

Networks can similarly be analysed at a number of levels, including national, regional, local, sectoral and technological. However, they are often interpreted to comprise economic relationships between a smaller set of industry players – typically just private-sector firms. A wide range of network types can be identified (see De Bresson and Amesse (1991), Freeman (1991); BIE (1991)), while value-chains and clusters can be interpreted as two broad types.

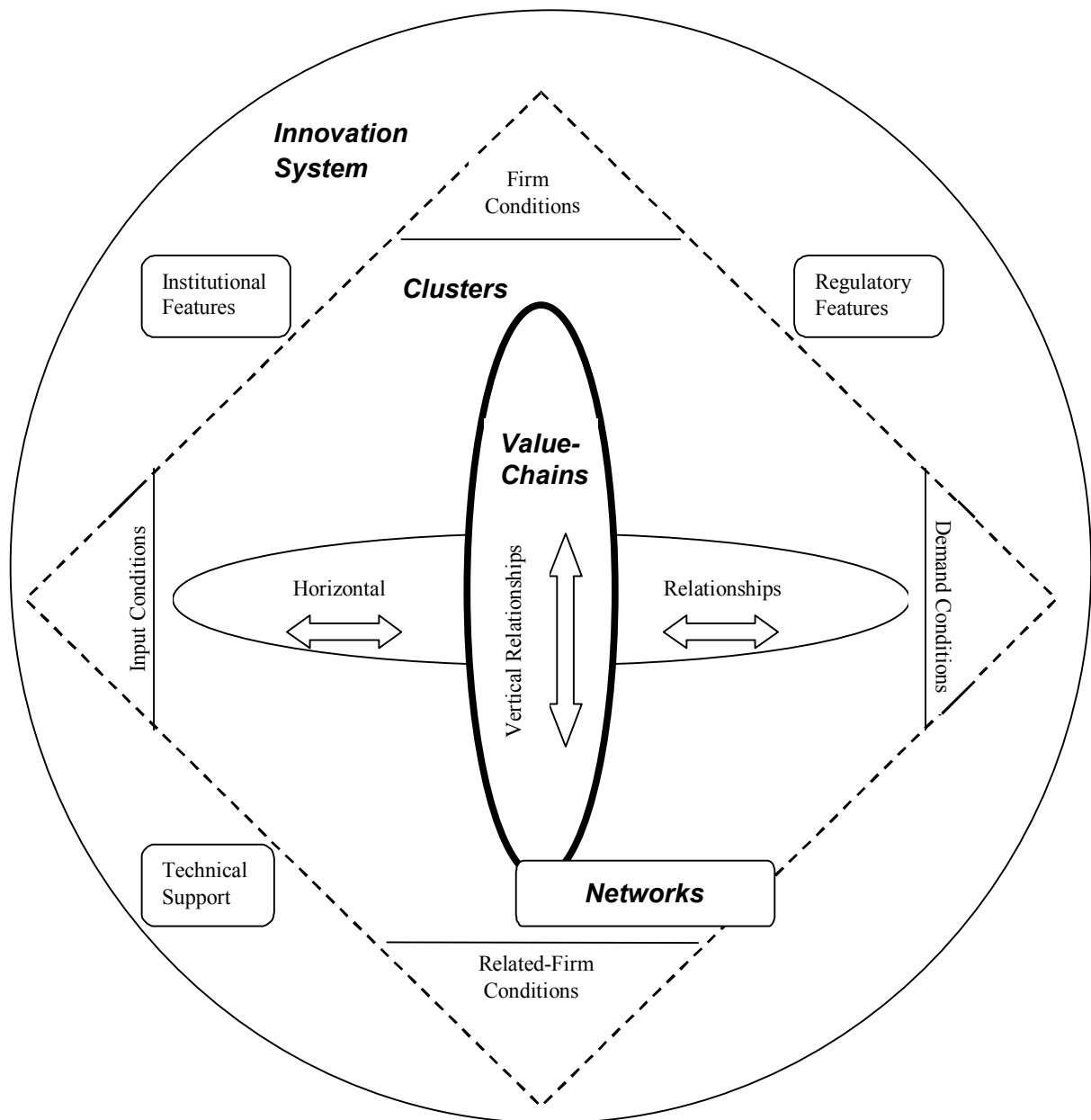
At one level, the *network* and *system* metaphors simply shift our attention from individual firms to groups of firms/organisations, the *relationships* between them, and their impact on economic activity – especially production and innovation. Networks/systems are groups of industry players pursuing economic outcomes by means other than simple one-to-one market transactions.

The value-chain and cluster perspectives highlight the importance of relationships in more focused contexts than generic network and system approaches. The value-chain perspective takes a relatively narrow view of inter-firm relationships, focusing on players making up the vertical supply-chain (linking various levels of users and producers). The cluster concept adopts a broader scope, including relationships between players linked vertically *and* horizontally, the latter being relationships between organisations at the same stage in the supply-chain – for example, relationships between suppliers of complementary outputs. This includes relationships between firms in completely different industries serving the same market. Further, unlike the value-chain perspective, the cluster approach emphasises the importance of geographical co-location of players in enhancing overall innovation performance. As a result, the cluster approach tends to be applied at the local level (compared to, say, the national level), where particularly dense inter-firm relationships are evident.

# Integration

The integrated framework shown in Figure 2 is intended to draw together the learnings associated with the four key frameworks discussed above.

Figure 2: The Integrated System Framework



The integrated framework concisely orders theoretical constructs drawn from the literature to arrive at a summary model. This approach combines the key features of four prominent options to overcome the limitations of using one, more narrowly focused framework. The integrated framework provides a useful guide for organising practical studies related to interactive innovation processes. In the context of sectoral, regional or national investigations, the integrated framework becomes the overarching guide incorporating cluster, value-chain, network and system-specific elements.

Focusing firstly on system-specific elements, attention is drawn to the area outside the cluster diamond. There are four system-specific elements, comprising the *technical support infrastructure* available to players in the system, and the *institutional* and *regulatory* features of the system that impact on innovativeness. The innovation system approach also evidences a comprehensive emphasis on *network(ing)* features (the diagram shows that the value-chain and cluster concepts also focus on these, though usually to a lesser extent). Hence the term *networks* in the diagram denotes both the network framework in its own right and the networking features of value-chains, clusters and systems.

The four system-specific elements – technical support, together with institutional, regulatory and networking features – are overviewed below.

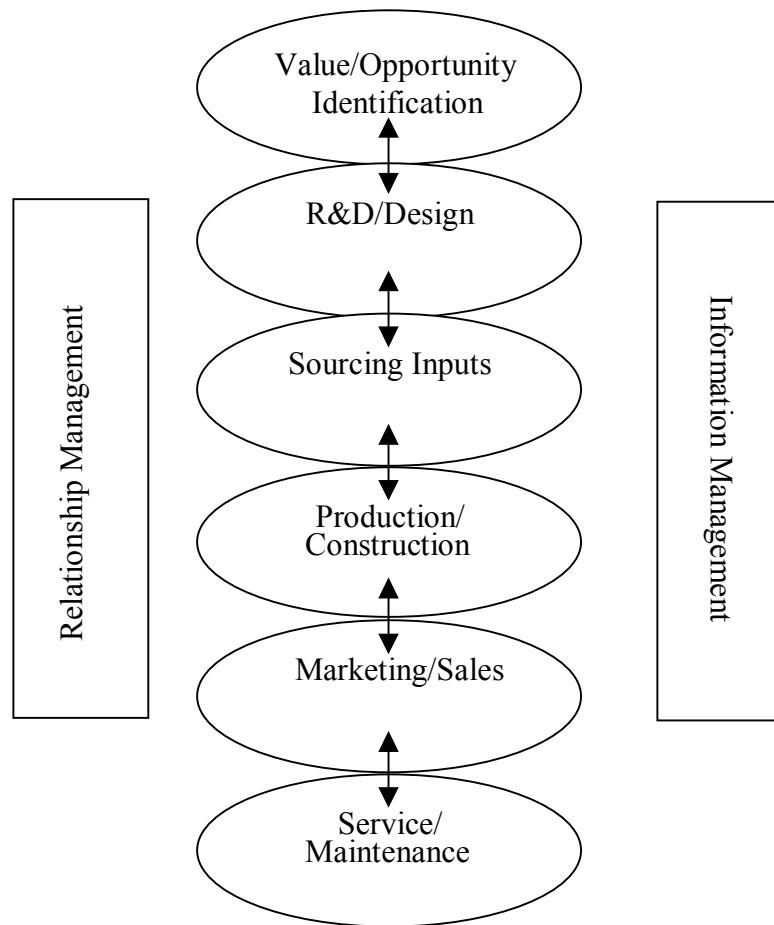
**Table 2: Key Features Impacting on the Efficacy of Knowledge Flows and Competence Building in Innovation Systems**

<b>Technical Support</b>	<b>Institutional Features</b>	<b>Regulatory Features</b>	<b>Networking Features</b>
<ul style="list-style-type: none"> <li>• R&amp;D centres</li> <li>• training/education bodies</li> <li>• professional associations</li> <li>• financial institutions</li> <li>• intellectual property rights</li> </ul>	<ul style="list-style-type: none"> <li>• rules of the game</li> <li>• conceptions of fairness</li> <li>• customs/traditions</li> <li>• routines</li> </ul>	<ul style="list-style-type: none"> <li>• technical specifications</li> <li>• safety standards</li> <li>• environmental regulation</li> <li>• industrial relations conventions</li> </ul>	<ul style="list-style-type: none"> <li>• linkage patterns and density</li> <li>• demand patterns</li> <li>• interactive learning</li> <li>• trust</li> </ul>

The broad view of the innovation system approach reflected in the integrated framework draws our attention to these critical variables which can support or hinder the knowledge flows and economic competence at the nucleus of an innovation system. Their importance is highlighted in the concluding section to this paper.

Returning to Figure 2, within the system, *value-chains* are conceptualised as a vertical spine of critical inter-firm relationships. Value-chain relationships include both in-house and inter-firm linkages, organised around a value delivery process, such as the simplified version shown below.

Figure 3: Simplified Value-Delivery Process



The circles in the above diagram show simplified stages in a typical value-chain, with two-way vertical flows. Relationship and information management are shown separately as they have been identified as the most important functions in value-chain management, with value maximisation being the driving force guiding the process. User-producer interaction (not shown) has also been identified as a critical variable in value-chains, being a function of relationship management efforts.

Finally, Figure 2 shows a *cluster* diamond, which focuses on both vertical and horizontal relationships, paying particular attention to Porter's (1990) four critical factors – firm conditions, input conditions, demand conditions and related-industry conditions. The dynamism of the cluster can be enhanced by high levels of localised rivalry and geographic concentration. The cluster approach also expands on the value-chains approach by focusing on both firm *and* non-firm organisations (not shown).

Figure 2 uses existing concepts to develop a useful multi-referenced approach which emphasises, in an ordered way, the complexity of interactions between myriad players in innovation processes. The integrated framework provides a first-cut of the literature summarising key innovation drivers and their broad relationships.

# Conclusions

This paper has outlined useful approaches to understanding innovation processes, for private-sector entrepreneurs and public-sector policy makers alike. Four key approaches have been investigated – systems, networks, chains and clusters. In order to better enable this material to guide practical investigations, a framework which integrates insights from each approach has been developed.

Systems thinking, together with network, value-chain and cluster thinking, has contributed a great deal to our understanding of effective innovation processes. Although the literature acknowledges that it is not possible to specify an ideal innovation process (Edquist 1997: 20), the following guidelines concerning the nature of well-performing processes are proposed:

- *Knowledge and Economic Competence*: An innovation system is more likely to be effective if it includes a diverse range of organisations with different types, and high levels of, economic competence. The system is likely to operate more effectively if it includes firm and non-firm organisations, demanding customers, and new industry players. Such features maximise complementarities between knowledge bases. The performance of the system will also be optimised if individual players effectively manage their value-chains.
- *Institutional Features*: It is best for the innovation system if there is a strong cultural emphasis on the importance of fairness and if local customs and routines reward innovativeness.
- *Technical Features*: Innovation system performance is critically affected by the quality and accessibility of the technical support infrastructure. R&D, training, education, finance and intellectual property arrangements need to be focused on innovation outcomes.
- *Regulatory Features*: Scope for innovation is maximised if technical, safety, environmental and other regulation is expressed in terms of ultimate performance requirements, instead of tightly specified prescriptive requirements.
- *Networking Features*: Maximum advantage will be gained if external linkages are dense, multistranded, long-term, knowledge-intensive, vertical *and* horizontal, market *and* non-market oriented, and inclusive of innovation, production and distribution relationships. Trust and robust user-producer relationships will also ideally be evident. Such factors support the development of effective dynamics within innovation systems.
- *Outcomes*: Innovation system outcomes will be maximised if individual participants perceive benefits beyond what they could achieve in isolation. The system is then more likely to be stable and productive.

In the rapidly changing environment of the 21<sup>st</sup> century, the ability of businesses and governments to generate growth and jobs will rest critically on their innovation performance. The integrated framework developed here is based on a new and increasingly popular ‘interactive’ approach to understanding and improving that performance. It provides a useful entry point for practical investigations of innovation processes.



## Notes

<sup>1</sup> It is beyond the scope of this paper to highlight how the innovation system approach varies across these types. In any case, the features discussed here cut across the various applications which may be adopted.

<sup>2</sup> Readers interested in exploring the literature on user-producer relationships should see Tether (2000), Sornn-Friese (2000), Fagerberg (1995), Shaw (1994), DeBresson and Amessee (1991), Porter (1990) and Von Hippel (1988).

<sup>3</sup> Although the cluster approach can also incorporate a broad range of organisations, this feature is more strongly associated with the system perspective.

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